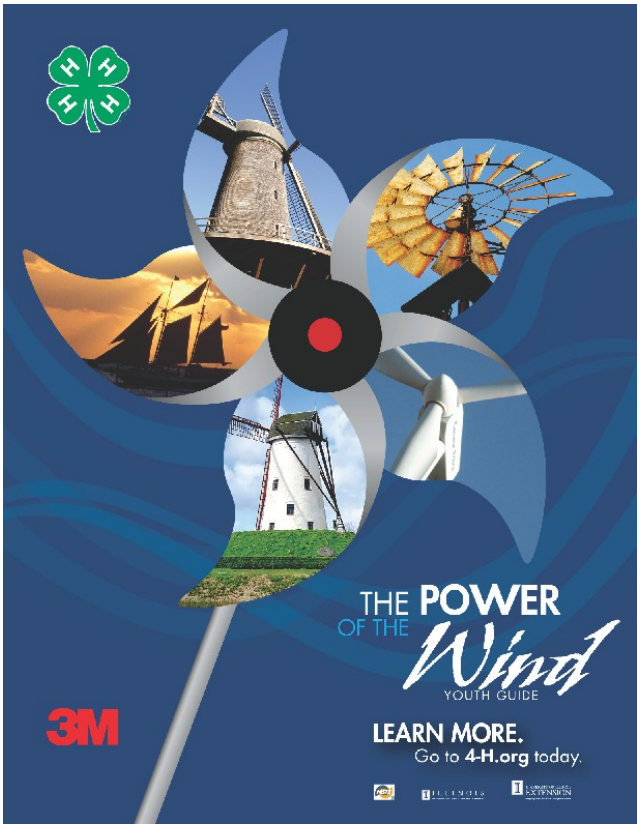
# Process Evaluation
# Power of the Wind Pilot Project

## A six state partnership to engage youth with wind energy




***Submitted by:***

***Pam Larson Nippolt, Ph.D.***
***University of Minnesota Extension Center for Youth Development***

***Amy Grack Nelson***
***Evaluation Consultant***

***October, 2010***

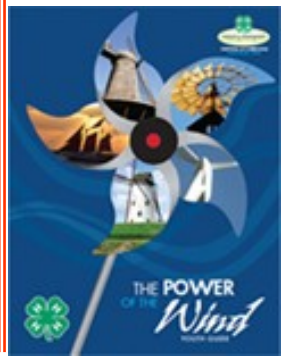
UNIVERSITY OF MINNESOTA
EXTENSION
Driven to Discover℠

3M

18 USC 707

# Table of Contents



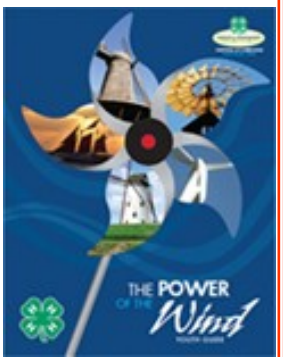


# Section 1: Overview of the Project

With financial support from the 3M Foundation, six University Extension youth development organizations in Iowa, Minnesota, Missouri, South Dakota, Texas, and Wisconsin piloted a program model to involve youth in learning about wind energy through engineering activities and inquiry-based learning methods. The activities were based on lesson plans from the Power of the Wind Curriculum (National 4-H Council, 2009). The project period, originally intended to span from January 2009 – December 2009, was extended to June 2010. The project was initiated in April 2009 with a two-day training for the team of Extension state partners and lead adult volunteers, or Master Explorers in the project. An advisory team of wind energy industry professionals, university faculty, and others also formed to support the model development in the early months of the project period.

A key goal of the project was to test a train-the-trainer model to orient and train adult facilitators (called "Master Explorers") who, in turn, trained Adult Explorers (other adult volunteers) in each state to work with youth in group settings to explore wind energy. The primary strategies for the pilot were to extend the written curriculum (facilitator and youth guides) by building adult facilitation skills to embed inquiry-based approaches into the lesson plans, to build adult and youth skills to form investigable questions and to design investigations, and to deliver the model within the context of non-formal learning environments of 4-H program after-school and club settings.

During the 18 months of the pilot project, 15 Master Explorers were trained, 137 other adults were trained as Adult Explorers, 3,353 youth of all grade levels were reached through events, and 356 youth participated in club or group Power of the Wind programming. In a survey of 28 youth participants, three-quarters of youth surveyed reported that being involved in the project increased their confidence in asking science-related questions and carrying out an investigation. This report details the process evaluation and results for the pilot project across the six states.



# UNDERLYING PROGRAM THEORY

When adult volunteers and paid staff (Master Explorers) are trained (using Power of the Wind curriculum) **to facilitate inquiry-based trainings** that build specific skills for adjusting facilitation approaches, help adult learners form their own investigable questions, design their own investigations, and use a positive youth development framework for working with youth, then they will be able to train other adult facilitators to work with youth in the project through in-person trainings, online resource sharing with peers and content specialists, and in-person coaching.

When adult volunteers and paid staff (Adult Explorers) participate in-person in inquiry-based training (using Power of the Wind curriculum), have access to online resource sharing, receive in-person coaching, and build skills in adjusting facilitation approaches, forming investigable questions, designing their own investigations that are inquiry-based, and using a positive youth development framework for working with youth, then they will:

- Demonstrate those skills with other adults,
- Demonstrate those skills in their work with middle school age youth,
- Increase their confidence in their ability to use the skills,
- Increase their skill level over time with practice and coaching.

When middle school-age youth participate in non-formal learning experiences (using Power of the Wind curriculum) with adult volunteers who use skills that adjust inquiry-based facilitation approaches, can guide youth in forming their own investigable questions, can guide youth in designing their own investigations, and use a positive youth development approach, then youth will:


- Form investigable questions,
- Design investigations related to wind energy,
- Engage with their Power of the Wind team,
- Have fun.

## IMPLEMENTATION STEPS FOR THE PILOT PROJECT

Following from the program theory for the project (p.4), the project implementation occurred over seven phases. Adjustments were made throughout the project period to meet the needs of University, Extension, volunteer and youth partners.

**Phase One: Integrate the Power of Wind curriculum into program design**

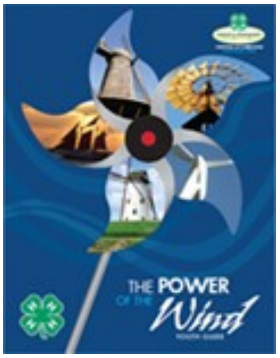
The piloted program design was centered on the content and lessons contained in the Power of Wind curriculum, a national 4-H curriculum released in 2008 and designed for youth ages 11 – 13 years. Learning objectives for the curriculum are based on knowledge gained by youth when they participate in activities related to wind energy and understanding the engineering principles related to wind energy power. Minnesota 4-H Youth Development educators applied an approach to inquiry-based learning that teaches adults how to adapt activities to vary the type of inquiry-based learning methods used when working with youth.

**Phase Two: Mobilize Multi-state Partnership.**

The 3M Foundation and Minnesota 4-H invited 4-H partners from Wisconsin, Iowa, South Dakota, Missouri and Texas to join the project. These six states are in the top twenty states for annual wind energy potential as measured in billions of kilowatt hours in the United States (American Wind Energy Association, 2008) and had an expressed interest in learning opportunities for youth related to wind energy. The partnerships were also selected and invited based on locations of 3M Corporation branch offices in order to involve corporate partners. An advisory group, with 3M Corporation membership, University faculty, and educators from the communities, was recruited and convened early in the project period to provide feedback on key implementation questions that were arising about the project and about the learning methods.

**Phase Three: Develop Adult Training Model**

The training design includes hands-on wind energy lessons and activities, with Master Explorers first participating as learners with the curriculum and activities, and then practicing with each other. During a two-day training/pilot implementation planning session that included 4-H staff and volunteers from each state. The train-the-trainer model incorporated three approaches to inquiry-based learning 1) directive or structured, 2) task-oriented or challenge and 3) open inquiry-adapted and based upon the Exploratorium® Institute for Inquiry® science education model and was focused most on process rather than content. Although the curriculum Power of the Wind was not designed as an inquiry-based curriculum, the goal was to train adults to adapt the lessons in order to build in inquiry-based learning methods, providing the adults with process skills to engage the interest of middle-school age youth in exploring wind energy through 4-H. Minnesota staff designed and led the training.



**Phase Four: Recruit Adults**

Master Explorers-as-trainers adapted the original training model and the lessons from the Power of the Wind (POW) curriculum for state-based trainings offered to adult volunteers. They then worked to recruit, train, and involve up to 8 Adult Explorers (AE) in each state to pair up and work directly with groups of youth. Wind energy professionals, those working in the wind energy industry or who were academic faculty in energy-related fields, were sought to team with state teams, participate in the trainings, and consult with the youth/adult teams on a regular basis. The two main trainers and three of the Master Explorers-as-trainers who started with the project experienced job changes during the project, which affected the pilot model plan. The involvement of other adults as AEs, and the inclusion of wind energy professionals occurred in varying degrees across the six states.

**Phase Five: Recruit Youth**

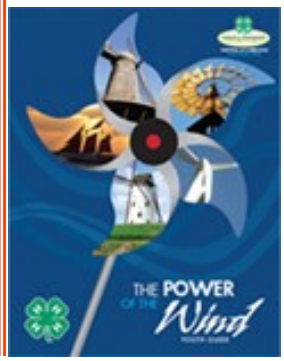
Approximately forty youth ages 11 – 13 years per state were expected to be recruited to participate in Power of Wind groups in each state. Youth from existing or newly forming 4-H community clubs and youth in afterschool programs (and their staff) were offered opportunities to participate through targeted marketing efforts. The actual number of youth reached through the project was much larger than planned for reasons related to the way the project was implemented in each state.

**Phase Six: Launch Project Across States**

The original design emphasized the connectedness of the groups across state lines with an expected launching of a common lesson in June 2009 to be offered via distance technology for youth/adult teams who began the project in the summer 2009. Youth clubs were not enrolled in the project during that summer as a result of longer than expected University IRB (internal review board) human subject processes. The shared "first lesson" was not feasible given the staggered starts in each of the states. A shared lesson was developed for adult facilitators, with materials that are appropriate to use with youth, in February 2010 and is available at www.extension.umn.edu/youth/mn4-H/projects/SET/power-of-wind/index.html

**Phase Seven: Connect Teams**

Additional strategies were tested to heighten the connection between the teams within each state and across state lines. After the first lesson, youth/adult teams were invited to join an online forum to exchange ideas with other teams, with wind energy contacts across the six states, and with 4-H paid staff across the six states. The ning site worked well as a place to store documents and tools for the project. Monthly webinars were led by Minnesota state staff that enabled the Extension partners to share best practices, provide information about the evaluation methods, and to keep the partners up to date on how implementation of the project was progressing in each state. Additional resources were built into the partnership to support the implementation at the state level.



Small model wind turbine kits (kidwind.org) were provided to each state along with copies of the curriculum. State partners were also given funds to support implementation costs of the project. Additional mini-grants at the mid-point and end of the project were made available so that each state partner could determine how to best use grant resources to meet the needs of the project within their state organization. The state case studies, reported below, outline how the resources were used.

## EVALUATION QUESTIONS AND METHODS

Evaluation questions and methods were developed to test the program theory. A multi-method approach to the process evaluation was used to gather perspectives of stakeholders who were key informants to the project implementation and feasibility of the model. Observation methods, survey methods, webinar notes, videotaped trainings and club meetings, and phone interviews were all used to track and understand how implementation occurred in each state and to determine whether or not the strategies that were implemented garnered evidence to support the program theory. Additional evaluation methods emerged over the course of the project in order to accommodate the changes in implementation of the pilot model. It was evident early on that testing the pilot model centered around the extent to which adults (Extension staff and adult volunteers) transferred the learning and approach of the initial training to other adults in their state organization through training.

## PROCESS EVALUATION QUESTIONS

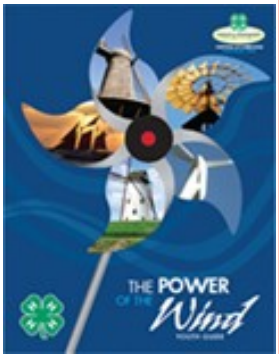
1) To what extent are adults able to effectively train other adults? This first question was not an original question but became central to the understanding of the feasibility of the pilot model.

2) To what extent are adults using the inquiry-based learning techniques in their wind energy youth/adult teams? (learning method)

3) To what extent are adult volunteers confident about guiding youth in the exploration of science topics related to wind energy and alternative energies? (content)

4) To what extent are youth interested and engaged in the Power of Wind team?

5) How effective are the efforts to connect teams within and across the six states in the pilot?



## Section 2: Process Evaluation Findings & Lessons Learned

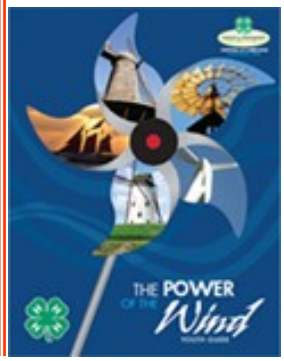
In this section, the evidence gathered throughout the project is summarized in relationship to the original evaluation questions that inform the program theory.

### 1. To what extent are adults able to train other adults?

The original design indicated that Master Explorers (MEs) would take what they learned from the original training and train others using the training script developed for the original training. MEs significantly adapted the training model both in order to fit individual state needs and because the original training stopped short of designing the state-level trainings. This feature both added to the innovation of the project and made it difficult to test the program theory. The partners' participation in the grant project enhanced the program design as evidenced from the number of states that ended up designing supplemental pieces, including Wisconsin's wind farm model, Missouri's wind farm PowerPoint presentation, and the KISS the Wind kits developed by Iowa. In two of the states, a shared training model was developed and staff teamed up across state lines to provide trainings together.

### 2. To what extent are adults using the inquiry-based learning techniques in their wind energy youth/adult teams? (learning method)

It appears that inquiry-based learning methods were applied in the youth groups involved in the project, as evidenced by the video tapes, the observations, and the reports from youth. Based on the two videotapes submitted that included youth, it appears that a guided (or task-orientated) inquiry-based learning method was most used in working with youth to challenge them to "Lift A Load" using wind energy.




### 3.To what extent are adults confident about guiding youth in the exploration of science topics related to wind energy and alternative energies? (content)

Thirty adults responded to the survey at the end of the project, allowing them time after they were trained to apply it in their work with youth on Power of the Wind. Nearly all respondents reported some level of

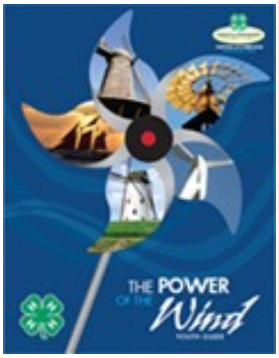
agreement that they were confident in working with youth to explore wind energy, but only just over half fully agreed that they were confident in doing this.

## 4. To what extent are youth interested and engaged in the Power of Wind team?

The original program theory was designed to deeply engage a relatively small number of adult volunteers and youth in the project. Instead, a focus on larger events in the early stages of the project touched, rather than engaged, much larger numbers of youth than expected. A total of 3,353 youth from pre-K to 12$^{th}$ grade were exposed to Power of the Wind lessons and concepts, with most of these youth (89%) reached through one-time events. Overall, 17 ongoing programs and 33 events took place during the grant period of the project. Groups included 4-H clubs, afterschool programs, and school day enrichment. Power of the Wind activities also occurred at one-time events such as state and county fairs, camps, festivals, conferences, and meetings.

Youth participating in groups had an overall positive experience with the project. A majority of youth had fun doing the activities and would like to do more in the future. Youth enjoyed the various hands-on lessons related to learning about wind power, including testing blades, making pinwheels, building turbines, and using circuits. Inquiry-based learning was an important aspect of the facilitation in 4-H groups, and a small percentage of youth specifically mentioned that they enjoyed being able to direct their own experience. Even though youth enjoyed the experience, only around a third talked about this experience with others, and less than half said they would recommend it to their friends.

The Power of the Wind activities provided youth with opportunities to learn about wind energy and scientific inquiry. Only a third of youth felt they could explain wind energy to someone else as a result of their involvement in the project. Although a majority of youth didn't feel completely confident in their ability to talk about wind energy with others, their curiosity was piqued by the topic. Youth also suggested that they would like more explanation about wind energy in their sessions.



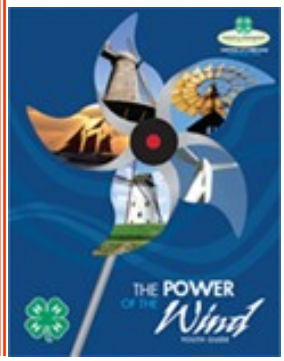
Youth confidence in carrying out the steps of the inquiry process also varied. Half the youth felt confident carrying out an investigation. However, lower percentages of youth felt confident asking science-related questions and planning an investigation. These responses are consistent with observations that investigations tended to be youth-led, while questioning and planning tended to be mostly or completely adult-led.

## 5. How effective are the efforts to connect teams within and across the six states in the pilot?

The youth/adult teams, as far as the evidence indicates, did not connect within or across the six states as a result of the project beyond those who became members of the project's ning site. The ning site offered a shared online space for pictures and a growing awareness of others involved in the project but it did not serve to "connect" teams in exchanging information during the course of the project. The project team focused resources to connect the state partners. As a result, monthly webinars were held with the group that attended the original training (Extension staff and adult volunteers) in order to keep communications channels open between the partner organizations.

## Overall Lessons Related to Implementation

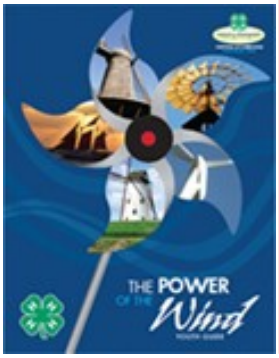
State partner staff started their state-level trainings after their respective university human subjects reviews were completed. As a result, the trainings for Adult Explorers did not occur until 2010 which was well beyond the original training of Master Explorers in early 2009. By June 2010, many of the states were starting to integrate Power of the Wind into shorter-term youth experiences and a few states had begun to work with youth for longer segments of time.




Although the project took time to get off the ground in the partner states (and many were still not yet working with youth groups at the end of the project period), the state partner staff report being committed to Power of the Wind (both the content area and their adaptation of the project model) and indicate that the Power of the Wind training and activities will live beyond the life of the grant.

The resources behind the project from the 3M Foundation helped some states implement the Power of the Wind curriculum and project at a more intensive level than they typically do with new curricula. One state staff member reported that the resources helped *"move the project along much faster than similar projects that have no resources."* Another state partner noted that the funds helped them purchase materials, something they typically don't have money for. *"What made this work is that there weren't a lot of strings attached to how you could spend the money. In the 4-H world, that was a lot of money. It was a generous allotment to the state that allowed us to purchase the equipment we felt we needed to roll this out….Typically have resources to get people to trainings but often don't have money to buy materials."*

Inquiry-based learning methods, both the training to use them and to prepare to train others to use them added an important dimension to the design of the project that required increased intentionality to adult education efforts. The length of trainings and the need for additional supports and resources also called for a greater commitment on the part of volunteers to the project. A potential volunteer (or staff member) may be interested in the content area, but may not have the same enthusiasm for the learning method. It was important that partners had a clear idea up front about the dimension of inquiry-based learning in the project and this can be improved in future models with observation, visuals, examples, and clearer descriptions of the method. These methods ultimately change, and hopefully enhance, the ways in which adults typically work with youth in 4-H. This project was effective in bringing together Extension professionals to jointly develop a multi-state pilot in which staff were able to test and implement new ways of working with youth. Based on the state partner reports on plans to continue, it appears that adult volunteers will become a part of that learning in larger numbers in the future.



# Section 3: State Overviews

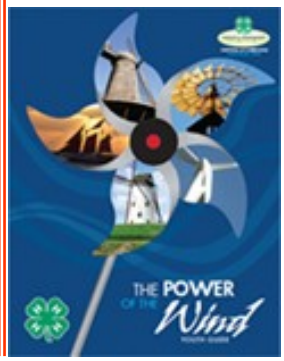
**TRAINING MODEL AND IMPLEMENTATION IN EACH STATE:**

Each state implemented the project with variations to the model. Overviews for each state's approach to the project, based on interviews with the Extension personnel main contact, illustrate the changes to the original implementation plan for each of the state partners. This information provides an important context for the evidence presented later in the report related to the original program theory. The focus of the interviews used was to understand how the training model was adapted and implemented in each state in terms of Adult Explorer AE) training, decisions behind their training models, use of grant resources, and subsequent work with youth. Five of the six state partners (Iowa, Minnesota, Missouri, South Dakota, Texas) offered at least one training similar in content and approach to the original train-the-trainer model. One state partner, Wisconsin, took a different training approach.

## Iowa

Early in the project, one of the three Iowa Master Explorers left the project due to a job change. Iowa's training model was similar to the model originally laid out in the project. Iowa's MEs offered three AE trainings. Two AE trainings occurred in March and April of 2010. Both of these trainings were seven and a half hours long and included training on both inquiry and POW activities. A total of 18 AEs were trained, which included participants with a variety of backgrounds – educators, 4-H staff, engineer, doctor, etc. Some of the AEs from these trainings have gone on to work with youth during one-time events, but have not yet carried out extended POW programming with youth. Some of these AEs are planning to begin extended programming in the summer of 2010.

Iowa also led a training for Green AmeriCorps volunteers in May 2010. An ME from Missouri assisted with the training. A total of 11 AmeriCorps volunteers participated. Volunteers included college students and recent graduates. The training was held over two days for a total of 15 contact hours and addressed inquiry and POW. These AEs planned to present to various groups, such as science camps, throughout the summer of 2010.




During the summer and fall of 2010, Iowa's MEs planned to provide AEs ongoing support and professional development through online trainings. They planned to schedule three to four Adobe Connect web conferencing sessions. These sessions provide AEs with more background information, allow the AEs to reflect on what has and hasn't worked with implementing POW activities, and provide an opportunity

for AEs to connect with experts in wind energy. The AEs have also requested an online discussion of the book "The boy who harnessed the wind" by Bryan Mealer and William Kamkwamba.

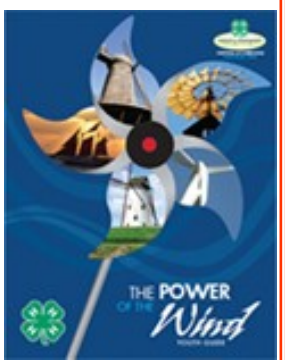
## Minnesota

Minnesota Extension staff designed the project's train-the-trainer model and, in fact, one of the Minnesota state leads that conducted the original training assisted MEs with their first trainings. The first two AE trainings were offered in May 2009 and included a mix of 4-H staff and volunteers. The trainings were each five hours long and similar in content to the original training, covering both inquiry and POW activities. After the training, some of the AEs went on to lead POW activities with youth.

In September 2009, one of the MEs trained one staff and three volunteers at the Rochester Multicultural Center. This training was also similar in content to the original training model. These AEs ended up leading POW activities with a 4-H club at the Multicultural Center.

In January 2010, one of the MEs worked with a 4-H Extension Educator to conduct a training for high school students and a Future Farmers of America instructor. They used the POW training guide, which was developed by the educator who led the original training, to structure their training. These high school students then went on to lead activities with two Renewable Energy 4-H clubs composed of 5th & 6th grade students.

In February 2010, Minnesota 4-H led a daylong training for Extension staff and community partners. The training was focused on the Kid Wind kit and inquiry-based learning. Mike Lindstrom, POW Advisory group member and Executive Director of SciMathMN, presented information about the engineering process, approaches to delivering the POW activities, how to use the various components of the Kid Wind kits, and suggestions for adapting the kits. Gillian Roehrig, STEM Research Center Director from the University of Minnesota, reviewed and led a hands-on session on inquiry-based learning in the afternoon. Most of the Minnesota AEs that were implementing POW programs attended the training. One of the MEs from Wisconsin also attended the training and brought a wind farm model to share with attendees. The training was videotaped and made available on the Minnesota 4-H POW site for the five grant partners to use as a resource.




During the summer of 2009, Minnesota used some of their grant funds to help pay for an interactive exhibit about renewable energy, the Pedal Power Bike. The bike was prototyped at the 2009 Minnesota State Fair. The fair provided an opportunity to test out the bike, see how it worked with visitors, and make improvements before it traveled around the state. During 2009 – 2010, the bike was made available to POW sites in southern Minnesota to use as a supplemental activity to POW activities.

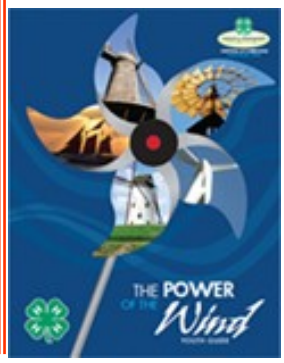
During the grant period, Minnesota created a POW web page to contain a number of resources related to the pilot project. One of these resources is a document which outlines how to implement POW activities, use what is available online on the Minnesota 4-H POW website, and access kits. This document was sent to all Minnesota Regional 4-H Educators and Program Coordinators as a guide for conducting POW trainings or to share with staff/volunteers who would like to lead their own POW youth activities. The other states' POW pages will also be linked from the Minnesota POW page. The intention of the linked web pages is for each state to retain ownership of their POW work, but also acknowledges that the resources are aligned and can easily be used together because they share common language and goals.

## Missouri

Missouri used the train-the-trainer materials but instead of MEs train AEs, the MEs trained additional MEs. The intent was that these new MEs would then go on to train AEs in the state (although this intended model was not implemented during the course of the project).

In September 2009, two 4-H youth specialists and eight frontline staff participated in a six and a half hour training focused on inquiry and POW activities. The expectation was that these MEs would then lead their own trainings. However, the MEs were reluctant to train others until they had more first-hand experience using the POW curriculum. For this reason, they focused on working directly with youth instead of training others, essentially functioning as AEs instead of MEs.

The plan of work process used in Missouri 4-H is designed so that staff plan 80% of their time almost a year in advance. The allocation of time for new programming and training led by educators, such as POW, needs to be planned for ahead of time. For this reason, the MEs primarily tested POW activities at single events with youth already enrolled in programs. One ME offered an extended POW program with youth over multiple weeks. Implementation of POW activities is more likely to occur during the current program year (and after the grant and pilot period). Missouri MEs focused on refining their training approach.




Missouri has provided various types of support for their MEs. They used their grant funds to buy an additional Kid Wind kit. Missouri supplemented their kits with the development of a PowerPoint presentation that illustrates how wind turbines are erected. This PowerPoint was also made available to the other grant partners. In addition to providing access to POW support, Missouri provided one-on-one support around inquiry through phone conversations with MEs.

# South Dakota

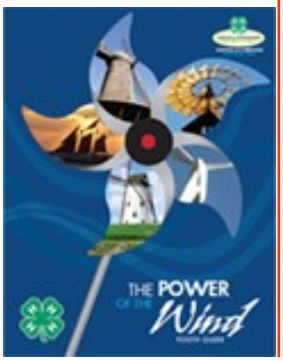
South Dakota MEs led a number of AE trainings that were similar in content to the original training model, but much shorter in length. The first training was in January 2010. The two and a half hour training included a mix of adult and youth leaders. These AEs have worked with youth during events, but didn't do any extended programming during the grant period. A second training was offered in May 2010 for out-of-school-time educators. In addition to training AEs, South Dakota had planned to train more MEs at the January POW workshop in Iowa. However, the workshop was cancelled due to weather so the individuals were never trained as additional MEs in the state.

South Dakota also provided training for youth leaders, which they called Junior Explorers. The training was a two hour session during their June 2009 statewide Teen Leadership Conference for youth ages 13 – 19 years. The training focused on wind, wind energy, and POW activities. Inquiry-based learning was not addressed. These youth then went back and led POW activities with upper elementary to high school youth. In

June 2010, the training was offered again at the Teen Leadership Conference and two of the youth leaders trained at the 2009 Teen Leadership Conference assisted with the training.

In March 2010, South Dakota State University's (SDSU) Engineering Department approached South Dakota 4-H for assistance with their school wind project. As part of this project, SDSU is erecting large-scale turbines at five schools monitoring the turbines. SDSU wanted South Dakota 4-H to do programming around wind energy for teachers at these schools. South Dakota MEs led a webinar where they presented information about inquiry and the POW curriculum . The teachers were interested in the curriculum, but not sure how it would work with their high school students.

At the March 2010 South Dakota State Leaders' Meeting, MEs provided a 50 minute educational event where they talked about scientific inquiry and the POW curriculum. Around 25 state leaders attended the event. Although this wasn't an official training because of the limited time frame, leaders were encouraged to use the POW curriculum after the event. South Dakota MEs have also presented to their Extension Advisory Board. The purpose of the presentation was to make the board members aware of the POW curriculum and what is happening in the state in regards to POW.




The POW curriculum is also being distributed in South Dakota outside of the grant-related activities. Every year, South Dakota 4-H purchases copies of new 4-H curricula and distributes them to 4-H educators. These educators are responsible for letting volunteers in their 1-3 county region know about new resources available to them. Although this report only captures POW activities influenced by the grant, POW activities are much more widespread in South Dakota.

## Texas

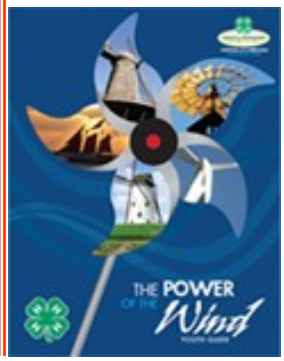
Texas also had a training model similar in content to the original training. In May 2009, a POW training was held for county extension agents. Originally the intent was to train volunteers as AEs. However, the Texas partners were unable to find interested volunteers, and decided to train four county extension agents. The training was an extension of a regional 4-H professional development training the agents were already attending. The AEs ended up participating in two separate five-hour trainings, for a total of 10 hours of training. After the training, the AEs received support through the kits and supplies made available to them through the grant.

Although four AEs were trained, only two remained involved in the project. During the course of the project, several Extension organizations implemented structural changes to maximize efficiency, and Texas 4-H moved from a model of regional agents to district agents. The four AEs had been trained with the regional structure in mind. The restructuring caused the project to lose some momentum and resulted in two AEs opting out of the project. Texas hopes to offer more AE trainings in the future with the intention of integrating POW into more districts.

The two AEs that remained involved in the project have both done some POW programming with youth. However, only one has offered extended programming. This AE team taught 7th grade students with a school teacher. They used the POW curriculum and kid wind kit. They also expanded on a few activities by tying them to topics of electricity generation and small generators. Due to the success of the project, the teacher and AE plan to make this an annual activity.

## Wisconsin

The two MEs in Wisconsin took different approaches to training AEs. One ME trained undergraduate students at the University of Wisconsin - Madison as AEs. The other ME was located in rural WI and found it best to train AEs by having them observe him implement activities with youth. Both of these approaches were chosen to best adapt the grant's program theory to the structure of their state.




During the summer of 2009, the ME housed at the University of Wisconsin-Madison led a few short trainings to help prepare for a more formal training in the fall. One was a short training for five volunteers at the University of Wisconsin-Madison Biotechnology center. One of the individuals trained ended up checking out a set of kits and implemented activities at a summer youth program. A second training was more of an informal two-hour meeting with an elementary teacher and an animal scientist interested in volunteering in the teacher's classroom.

The teacher and scientist plan on implementing wind activities into a science club with 4th and 5th graders during the 2010-2011 school year. A third training was for a 4-H agent, library staff member, and two library volunteers. This two-hour training occurred over two sessions and included introduction to the POW curriculum and how to turn the wind turbine activity into an inquiry activity. The 4-H agent then worked with the library to offer four weeks of POW Activities during the library's weekly summer 4-H club for youth ages 9-11.

In September 2009, the ME trained University of Wisconsin-Madison undergraduate students enrolled in a service-learning course. The ME started by providing an hour training to two faculty members and an AmeriCorps VISTA volunteer working with the class. They then worked with the ME to plan a training for the college students. Since inquiry learning had already been covered in the course, the one and a half hour training focused on POW activities. After the training, the students presented POW activities as part of eight-week afterschool science clubs for 3rd – 5th graders in Madison.

In November 2009, the ME from Madison offered a training as part of the Wisconsin 4-H Southern District meeting. A total of 15 4-H educators and 3 VISTA volunteers were trained at the meeting. The training was one and a half hours long, plus a 45-minute wind tour. This training was a shortened adaptation of the Morris training and was a way to get counties interested in POW. The second ME was in rural Wisconsin decided to take a different approach to training when initial efforts to recruit adults were not successful. The ME went out and worked directly with youth so he could learn to deliver the program. During the POW programming, he brought in adult leaders to assist with the program. He found it easier to recruit adults to work with POW if they saw it "in action" and assisted with activities.

He started this method by working with a 4-H club during one of their hour-long meetings. During the meeting, the club leaders observed him doing POW with youth. The ME also led a six-part series of a SET club for 7th graders at a local school. A teacher assisted with delivering the POW activities, although she didn't receive prior training. Finally, the ME presented POW activities and had adult leaders observe him during a 4-H winter camp for 8th – 12th graders. POW was a theme for the weekend and POW activities were offered daily over three days. The ME worked closely with one of the volunteers to organize the content of what was delivered during the POW sections of the camp. Adult leaders (four county educators, four volunteers) then watched the ME deliver the activities during the camp and learned about POW through the process.


The ME also created a wind farm model that he used with various POW activities he led. The wind farm model was a docking station for four of the Kid Wind turbines. With the 4-H winter camp, he spent the first two days having the youth come up with wind turbine designs and then the last day they created the wind farm. The ME also shared the wind farm model at the February 2010 training in Minnesota. The use of the

model was videotaped and made available to grant partners on the Minnesota 4-H website along with the other videos from that training (see Minnesota's description above).

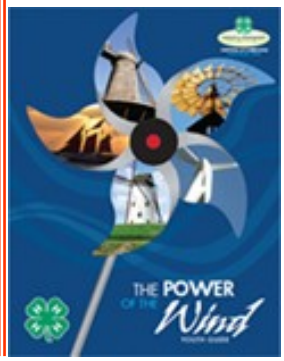
In April 2010, a five-hour training took place in Eau Claire for county educators. A total of 18 people were trained. This included 12 county educators, an agricultural agent, three 4-H volunteers, and two VISTA volunteers. At the conclusion of the training, six of the counties took with them a Kid Wind kit that they have committed to use with youth in their county. A majority of the county educators are also on the state Science, Technology, Engineering, and Math team, which will help to ensure POW will continue to be supported throughout the state. MEs are planning to follow up with these AEs through conference calls to discuss what the AEs have done since the training, what worked well, what didn't work as anticipated, and their plans for working with youth. The hope is these AEs will go on to train others and/or work directly with youth.

## PARTNER USE OF GRANT RESOURCES: KITS AND MINI-GRANTS

As part of the grant, each state received Kid Wind kits. These kits were valuable tools for implementing POW activities, as evident by mini-grant requests for funds to develop more kits or provide supplemental information for the kits. Iowa, Missouri, Wisconsin, and South Dakota all submitted mini-grant requests toward the end of the project. Funds were used to purchase more Kid Wind kits, develop new kits, or develop online resources based on the kits. The Kid Wind kits provided by the grant and the kits developed through the mini-grants will continue to be used beyond the life of this project.

Iowa used their mini-grant to develop KISS (Keep it Simple Student) the Wind kits. Iowa had already begun to develop a wind turbine model kit before the POW grant and the mini-grant funds allowed them to devote time to refining and completing the kit they had started. Iowa also created video clips that provide instructions for using the materials in the kit. The KISS the Wind kits were distributed to all the states involved in the grant.

Missouri's mini-grant focused on creating short videos that demonstrated the steps and stages of inquiry learning using the KISS the Wind kits developed by Iowa. A Missouri ME attended Iowa's Green AmeriCorps training to capture video for the project. The video was then integrated into an online, interactive resource to help individuals understand the inquiry process (moving from directed inquiry to "task-oriented" or guided inquiry) and the scientific method.



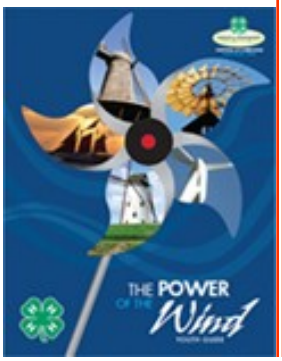

With their mini-grant funds, South Dakota created six traveling kits. They will supplement the kits with an instructional DVD of best practices for using the kit. The kits will be available for volunteer, staff, and youth leaders in their state to check out for up to four weeks.

The long time period is to encourage groups to use the kit more than once with their group. One kit will be used for promotional purposes at various 4-H camps, regional fairs, etc to let people know the kits are available to check out.

Wisconsin purchased additional Kid Wind kits with their mini-grant funds. Wisconsin found the Kid Wind turbines to be well designed for inquiry learning and discovered that it was best to have one kit for every three or four youth, so they focused dollars on additional kits so that more youth could have direct experience with the wind turbines. These kits will be available to share among counties in Wisconsin, with priority to settings in which staff or volunteers have attended POW training and are planning to deliver POW programming. Wisconsin also used mini-grant funds to create instructional videos for the kits that will be posted on their 4-H website.

## ADVISORS AND KEY SUPPORTS

The 3M Foundation program officer and Extension leaders provided key support in identifying University, community, and corporate partners who agreed to serve on an advisory team that met during the early stages of the project. These eleven individuals were directly tied to the wind energy industry, to the engineering field, or to educating young people in STEM content areas. While all state partners were invited to recruit advisors to the group, all but one of the members were based in Minnesota. Advisors met to discuss and provide ideas related to questions that were raised by the state partners related to implementing the project. For example, one advisory group member was instrumental in arranging and leading a presentation about and tour of the wind turbine facility in Morris, Minnesota from the group of Master Explorers initially trained during the pilot. Another advisor was instrumental in designing and providing a training to Master Explorers midway through the project. That training, in partnership with a University professor of curriculum and instruction, was videotaped and archived for ongoing online training for adults.



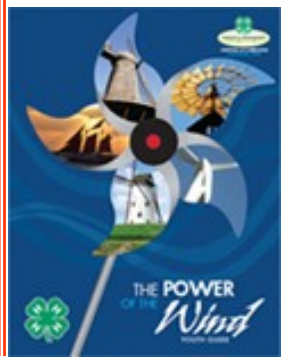
# Section 4: Training Adults

To what extent did the adults involved in the project (both ME's and AE's; paid staff and volunteers) view themselves as prepared and comfortable to use inquiry-based approaches while exploring wind energy materials and concepts with youth?

The state overviews illustrate that five of the six states, with the exception of Minnesota, placed Extension staff in the ME role in the project. In Minnesota, of the two volunteer ME's originally recruited, only one volunteer was still active with the project. Conceptualizing the ME role as a volunteer role had a great deal of appeal in the design phase as a method that could sustain the project beyond the pilot phase, but was not realized within the pilot phase. This change raises questions about how and when to best involve adult volunteers in delivering new program models that require extensive training and methods for working with youth. There is evidence that state-led trainings effectively integrated the inquiry-based learning methods into their training models. Several state partners videotaped trainings with adults as part of the process evaluation and with the intent to document the methods that were taught during trainings provided across the project. One state partner also videotaped AEs working with young people on Power of the Wind activities and lessons. These tapes illustrated that AEs in some states were specifically trained to embed inquiry-based learning methods within the wind energy content and activities of the curriculum. In Iowa and Missouri, the inquiry-based learning method taught to adults most closely resembled guided inquiry, which the trainers referred to as "task-oriented" inquiry. This method challenges the learner to explore, question, and test designs in order to accomplish a task. These trainings focused on the use of two specific lessons in the POW curriculum - Build A Pinwheel and Lift A Load - which were used to guide adults and youth to use inquiry-based methods to explore wind energy principles.

## MASTER EXPLORERS (PAID STAFF AND ADULT VOLUNTEERS)

At the end of the project, the smaller group of MEs involved since the initial stages of the project were invited to participate in an online survey. The purpose of the survey was to gain feedback on their experience throughout the course of the project and measure the effectiveness of the project in meeting its goals. Of the 15 MEs that were invited to complete the survey, 11 responded for a 73% response rate.




Master Explorers who responded to the survey were from five out of the six states involved in the grant. Wisconsin had five MEs respond, South Dakota and Wisconsin each had two responses, Iowa and Minnesota each had one, and Texas had no MEs complete the survey. Overall, a similar number of males and females responded, six males and five females.

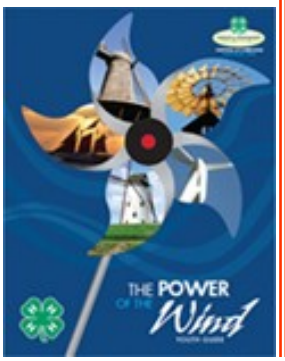
Most MEs had prior experience working with Extension or 4-H. Of the 11 MEs responding, 10 were Extension employees and one was an adult volunteer. Eight MEs had eight or more years of experience. Only one ME was new to Extension or 4-H. Although most MEs had prior experience with Extension and/or 4-H, only two had experience working in wind energy, either professionally or personally. One ME said they had between 1-4 years of experience and the other had between 5-8 years of experience.

MEs became involved in the 4-H POW project for a variety of reasons. Most MEs noted the importance for youth to learn about wind energy, as well as renewable energy in general. Some MEs also felt wind energy was a relevant topic for their audience because of wind farm development in their state. When asked if they would continue their involvement with POW activities after the completion of the grant, all of the MEs said they would continue working with POW in their state.

### *Main reason MEs decided to become involved in POW project (n=10)*

- Wind energy in my state is a great topic because of public awareness and economic impact. Great chance to promote in my state.
- We have significant wind farm development in the area that I serve.
- Concern for the future of wind power in my state.
- Because there are many new wind farms being constructed in our area. It was an opportunity for me to learn more about wind power.
- Our nation desperately needs to become more reliant on clean, renewable sources of energy. Teaching about the Power of Wind is one step in opening up a "world of possibilities" to our youth.
- An interest in renewable energy and grant funding.
- I feel it is important for youth to understand Wind Energy, so that they can be knowledgeable about it for future use because it is a great resource.
- To gain knowledge to educate youth in the wind industry
- Encourage creative problem solving and engineering skills in youth, learn more about wind power and the future of energy production, support green energy
- Teaching about and preparing youth to face environmental issues.

The Master Explorer role was designed to carry out programming and evaluation responsibilities during the project, with direct responsibility to recruit and train AEs. During the trainings they provided, ME's gathered evaluation data through videotaping the training, administering a post-training survey, and completing a training debrief form after each training they provided. After the training, the ME followed up and observed AEs as they began to work with youth, using an observation tool designed for the project. The tool served as both a data collection instrument and a structured guide for MEs to provide feedback to AEs after observing them. MEs were also involved in monthly webinars, completed mini-grant projects, and led some of their



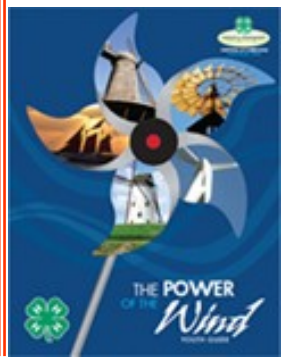
own youth activities. MEs were asked about the time commitment that was required of them during the project. As illustrated in Table 1, most MEs felt the time commitment was clearly communicated at the beginning of the project. However, two MEs felt the commitment wasn't communicated as clearly as it could have been.

### *Table 1: MEs' reflection on the project's time commitment (n=11)*

| | Disagree | Disagree a little | Agree a little | Agree |
|---|---|---|---|---|
| The time commitment was communicated clearly up front by the person who invited me to participate. | 0 | 2 | 1 | 8 |

### *Table 2: MEs' level of preparedness to train AEs (n=11)*

| | Disagree | Disagree a little | Agree a little | Agree |
|---|---|---|---|---|
| As a result of the Power of the Wind project, I was well prepared to find ways to embed inquiry into the Power of the Wind curriculum. | 0 | 0 | 4 | 7 |
| As a result of the Power of the Wind project, I was well prepared to *t*rain other adults to work with middle school age youth to learn about wind energy. | 0 | 0 | 5 | 6 |
| As a result of the Power of the Wind project, I was well prepared to train other adults to guide youth to form questions that they could investigate. | 0 | 0 | 6 | 5 |
| As a result of the Power of the Wind project, I was well prepared to train other adults to guide youth to design an investigation to answer a question. | 0 | 0 | 6 | 5 |
| As a result of the Power of the Wind project, I was well prepared to provide constructive feedback to other adults related to the methods used in the project. | 0 | 1 | 5 | 5 |




As shown in Table 2, around two-thirds of MEs felt well prepared to find ways to embed inquiry into the POW curriculum. Around half the MEs felt well prepared to train other adults (AEs) in working with middle school youth around wind energy, to guide youth to both form investigable questions, and to design an investigation to answer one of their questions. Part of the ME's role was to offer support and feedback to the AEs. Fewer MEs felt well prepared to provide constructive feedback to other adults around the inquiry-based learning methods used in the project, with one ME expressing some disagreement that they felt prepared.

As shown in Table 3, all MEs viewed both the overall POW project and the curriculum generated youth and adult interest in wind energy in the communities that they work with.

### *Table 3: Role of POW in generating interest in wind energy (n=10)*

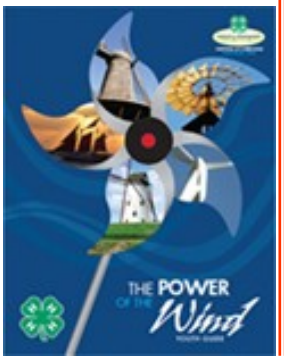
| | Disagree | Disagree a little | Agree a little | Agree |
|---|---|---|---|---|
| I think the Power of the Wind curriculum has played a key role in generating interest in wind energy in youth and adults in communities. | 0 | 0 | 7 | 3 |
| I think the Power of the Wind project has played a key role in generating interest in wind energy in youth and adults in communities. | 0 | 0 | 5 | 5 |

MEs were asked how AEs translated what they learned during their AE training into working with youth. Overall, MEs saw at least a little increase in AEs' confidence with the wind energy content and leading inquiry-based learning activities with youth. As illustrated in Table 4, a majority of MEs agreed that AEs were able to explain wind energy, were more confident answering youths' science-related questions, and were more confident planning an investigation with youth. There was slightly less agreement that AEs felt more confident carrying out an investigation with youth.

### Table 4: MEs' reflections on AEs post-training abilities (n=10)

| | Disagree | Disagree a little | Agree a little | Agree |
|---|---|---|---|---|
| The adults I worked with are able to explain wind energy to youth. | 0 | 0 | 3 | 7 |
| Over the course of the project, the adults I worked with seem more confident asking science-related questions with youth. | 0 | 0 | 4 | 6 |
| Over the course of the project, the adults I worked with seem more confident planning an investigation with youth. | 0 | 0 | 4 | 6 |
| Over the course of the project, the adults I worked with seem more confident carrying out an investigation with youth. | 0 | 0 | 6 | 4 |

MEs were asked how the POW project and curriculum could have been improved. MEs' suggestions to improve the training and support they received included offering more training, improving the IRB process, and increasing publicity of the project. Three MEs didn't have any suggestions. See MEs' suggestions to improve training and support can be found in Appendix A.

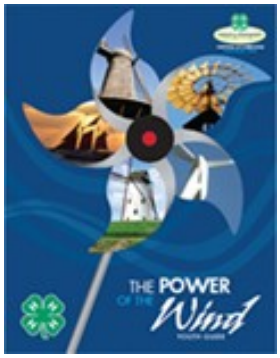


## ADULT EXPLORERS
## (PAID STAFF AND ADULT VOLUNTEERS)

Adult Explorer's were asked to rate their level of comfort in delivering key learning methods and strategies from the program model for the project immediately after completing the trainings that were offered in the six state organizations. The AEs participating in the survey represented Iowa (18 respondents), South Dakota (15 respondents), Wisconsin (4 respondents), and Minnesota (15 respondents). Overall, ME's trained a total of 102 adults in their state organizations after receiving the training in April 2009. Fifty-two adult trainees completed the survey directly after completing the training.

### *Table 5. Adult Explorer Post-Training Feedback. (n=52)*

| | Comfortable | Somewhat comfortable | Somewhat uncomfort-able | Uncomfort-able |
|---|---|---|---|---|
| Working with middle school age youth to learn about wind energy. | 41% | 51% | 8% | 0% |
| Using the three approaches of teaching when working with youth. | 32% | 62% | 6% | 0% |
| Guiding youth as they form questions that can be investigated. | 40% | 58% | 2% | 0% |
| Guiding youth as they design an investigation to answer a question. | 38% | 50% | 4% | 0% |
| Finding ways to embed inquiry into the Power of the Wind curriculum. | 39% | 49% | 12% | 0% |
| Receiving constructive feedback from other adults related to the methods we practiced in the training | 53% | 43% | 4% | 0% |
| Providing constructive feedback to other adults related to the methods we practiced in the training | 37% | 55% | 4% | 0% |



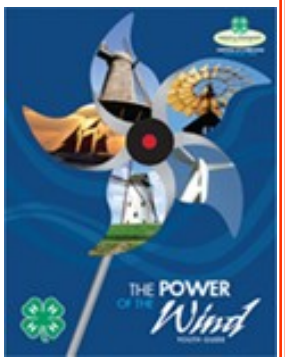

As shown in Table 5, participants reported being most comfortable in guiding youth as they form questions and design an investigation, and in receiving constructive feedback from other adults. Participants were least comfortable providing constructive feedback to other adults and embedding inquiry into the Power of the Wind curriculum. The three approaches to teaching through inquiry-based methods, as adapted from the Exploratorium® Institute for Inquiry® model, were part of the design of the original train-the-trainer model but not incorporated into all trainings offered in each state, and this was reflected in the open-ended comments.

A key strategy for the project was the design and implementation of a training method that would transfer to the direct facilitation that the adults provided to youth during the exploration of wind energy and the curriculum. The AE role was implemented in various ways across the six states and, overall, many Extension personnel filled the AE role rather than adult volunteers. Thirty individuals completed the Adult Explorer online survey, providing input about the effectiveness of the project in reaching the training and delivery goals. Of the thirty adults responding at the end of the project period;

- 22 were female, 8 male,
- 16 were Extension personnel, 8 were adult volunteers, 6 were in another role,
- Respondents were from Minnesota, Iowa, South Dakota or Missouri,
- Eight were involved with 4-H for the first time, 11 were involved with 4-H for 8 years or longer, 11 were somewhere in between first time and 8 years of involvement,
- 70% of respondents planned to continue with the Power of the Wind project work.

### *Table 6. Adult Explorer Survey Results (n=30 adults).*

| Through my involvement in the training and the Power of the Wind project….. | Disagree | Disagree a Little Bit | Agree a Little Bit | Agree |
|---|---|---|---|---|
| I was well-prepared to work with middle school age youth to learn about wind energy. | 0% | 3% | 43% | 53% |
| I was well-prepared to guide youth to form questions that they could investigate. | 0% | 3% | 50% | 47% |
| I was well prepared to guide youth to design an investigation to answer a question. | 0% | 0% | 60% | 37% |
| I was well-prepared to find ways to embed inquiry into the Power of the Wind curriculum. | 0% | 10% | 37% | 53% |
| I received constructive feedback from other adults related to the methods I used in the project. | 13% | 13% | 40% | 30% |
| I think the Power of the Wind curriculum has had a key role in generating interest in wind energy in youth and adults in my community. | 3% | 10% | 33% | 53% |
| I think the Power of the Wind project has had a key role in generating interest in wind energy in youth and adults in my community. | 3% | 20% | 50% | 27% |



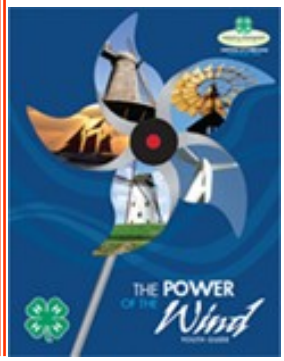

While AE's were primarily in agreement that they were well prepared to work with middle school youth, to guide youth in learning about wind energy by forming questions and designing investigations, the agreement level was quite mixed between "agree" and "agree a little bit." In other words, the confidence level of adults who were trained during the project and responded to the survey is not clearly stated. Over a quarter of those surveyed disagreed that they had received constructive feedback during

Adult Explorers were also asked about their agreement with the role of the curriculum and project in generating interest in wind energy. Nearly one quarter disagreed that the project had a key role in generating interest in their community.

The Adult Explorer responses, shown in to the following Table 7, provide their perspective on the degree to which the project effectively engaged youth in wind energy and inquiry-based learning. Most all (90%) agreed that Power of the Wind was effective in making youth more curious about wind energy. From the adults' perspective, the youth were most effective in being able to explain wind energy concepts to another person. Over three quarters of respondents agreed at some level that youth they worked with were more confident asking questions, planning an investigation and carrying out an investigation after their involvement. However, AEs strength of agreement is much lower when considering inquiry-related skills, with just over one quarter agreeing that youth seem more confident asking questions and planning an investigation, and just over one-third agreeing that youth seem more confident carrying out an investigation. Nearly one quarter of AEs responded that they disagreed that youth seem more confident in planning an investigation as a result of their involvement in POW.

## Table 7. Project Effectiveness with Youth per AE. (n=30 adults)

| | Disagree | Disagree a Little Bit | Agree a Little Bit | Agree |
|---|---|---|---|---|
| 4-H Power of the Wind was effective in making youth more curious about wind energy. | 3% | 7% | 30% | 60% |
| The youth I worked with are able to explain wind energy to someone else. | 3% | 10% | 30% | 53% |
| Because of Power of the Wind, the youth I worked with seem more confident asking science-related questions. | 3% | 13% | 57% | 27% |
| Because of Power of the Wind, the youth I worked with seem more confident planning an investigation. | 3% | 20% | 47% | 27% |
| Because of Power of the Wind, the youth I worked with seem more confident carrying out an investigation. | 3% | 10% | 50% | 37% |



# Section 5: Youth Involvement

POW grant-related activities reached varying numbers of youth across the six states. As illustrated in Table 8, a total of 3,353 youth were exposed to POW activities as a result of the grant, with a majority of those numbers (89%) coming from one-time events. Wisconsin had the highest number of overall youth reached and the most youth reached through events. Minnesota had the highest number of youth reached through extended programming, or groups, with Wisconsin a close second. South Dakota was unable to get groups established during the grant period, but reached a high number of youth through their events.

## Table 8: Numbers of youth reached by state

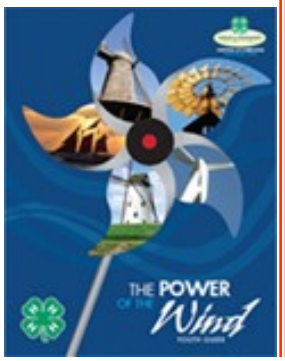
| State | Total number | Number of youth reached through groups | Number of youth reached through events |
|---|---|---|---|
| Wisconsin | 1705 | 144 | 1561 |
| South Dakota | 959 | 0 | 959 |
| Texas | 227 | 10 | 217 |
| Missouri | 202 | 19 | 183 |
| Minnesota | 183 | 153 | 30 |
| Iowa | 77 | 30 | 47 |
| **Grand Total** | **3353** | **356** | **2997** |

### POWER OF THE WIND GROUPS

Extended programming, or groups, occurred in five of the six states. A total of 17 groups occurred as a result of the grant. As shown in Table 9, Minnesota and Wisconsin had the most groups as well as the highest numbers of youth reached through group activities. Most of the states reached a wide variety of ages through their groups from elementary to high school. The types of groups reached by the five states included groups such as 4-H clubs, afterschool programs, and school day enrichment (see Appendix B for descriptions of the groups offered in each state).

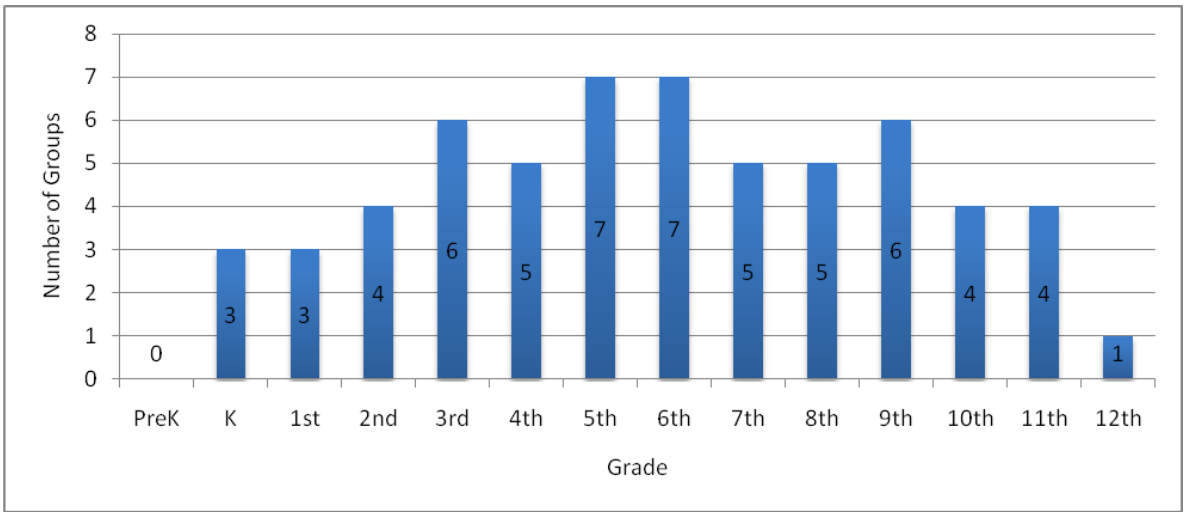
## Table 9: Youth reached through groups

| State | Number of Groups | Total number of youth reached | Grades reached |
|---|---|---|---|
| Minnesota | 7 groups | 153 | K – 11th |
| Wisconsin | 6 groups | 144 | 2nd – 12th |
| Missouri | 2 groups | 19 | K-3rd, 5th – 11th |
| Texas | 1 group | 10 | 7th |
| Iowa | 1 group | 30 | 4th – 11th |
| South Dakota | None | 0 | -- |



Although the POW curriculum was intended for grades 6-8, 4-H groups involved in the project were typically clubs that include a wide variety of ages. As illustrated in Figure 1, five or more groups reached grades 3 – 9. The curriculum was also adapted for early elementary and high school students.

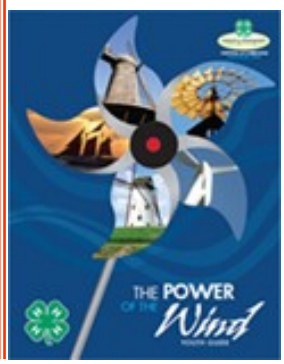
## Figure 1: Grade levels reached by groups (n=15 groups)




Adults recruited youth using a variety of methods. Thirteen of the groups reported on how they recruited youth. Common recruitment methods included print marketing and direct communication with youth and/or their parents. Listed below are the various types of methods used by groups.

## Recruitment methods (n=13)

- Brochure, flyer, word of mouth.
- Brochure, flyer, word of mouth.
- Community education flier.
- Newsletter, phone calls, fliers.
- Newspaper, radio, public access television, fliers, announcements at Boys & Girls Club and Public Library.
- School newsletter, sign up, school announcements, information sheets sent home to parents.
- Fliers, sign up for parents during class registration for enrichments classes for home school.
- One of the 4-H members from this 4-H Club enrolled in the Power of Wind 4-H project for the 2009-10 year and whole club participated.
- County Extension Agent mentioned an activity for 4-H Club to participate in and teacher at school offered her class.
- A community member mentioned the program that 4-H was using to teach about wind power. I contacted the county agent to get my classes involved.
- Signed up for the experience as part of a SET club.
- Afterschool program youth participated.
- All were part of the afterschool/tutoring program.



## POWER OF THE WIND EVENTS

In a departure from the program model which did not include events as a delivery strategy, several POW events were planned and implemented during the pilot phase. Power of the Wind events were held in all six states and were, in retrospect, an important outreach strategy over the period of the project. A total of 33 events occurred as a result of the grant. Wisconsin had the most events and reached the highest number of youth (see Table 10). Most of the states reached a wide variety of ages through their events from elementary to high school. POW activities occurred at a variety of events in the six states including state and county fairs, camps, festivals, conferences, and meetings (see Appendix C for descriptions of events by state).

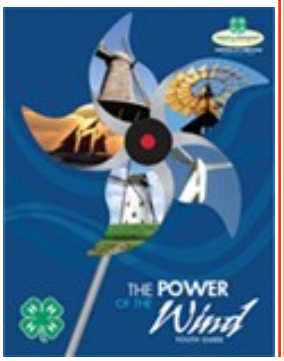
### Table 10: Youth reached through events

| State | Number of Events | Total number of youth reached | Grades reached |
|---|---|---|---|
| Wisconsin | 12 events | 1561 | PreK-12th |
| South Dakota | 7 events | 959 | PreK-10th |
| Missouri | 7 events | 183 | 4th – 12th |
| Iowa | 4 events | 47 | 1st – 7th, 9th – 12th |
| Texas | 2 events | 217 | 3rd – 5th |
| Minnesota | 1 event | 30 | K – 12th |

Events reached a wide age range of youth. As illustrated in Figure 2, all of the grades were reached by at least five events. Grades 4 – 7 were reached by the most events (18 or more events). Note: One of the events didn't report grade levels, which is why Figure 2 is based on 32 events.

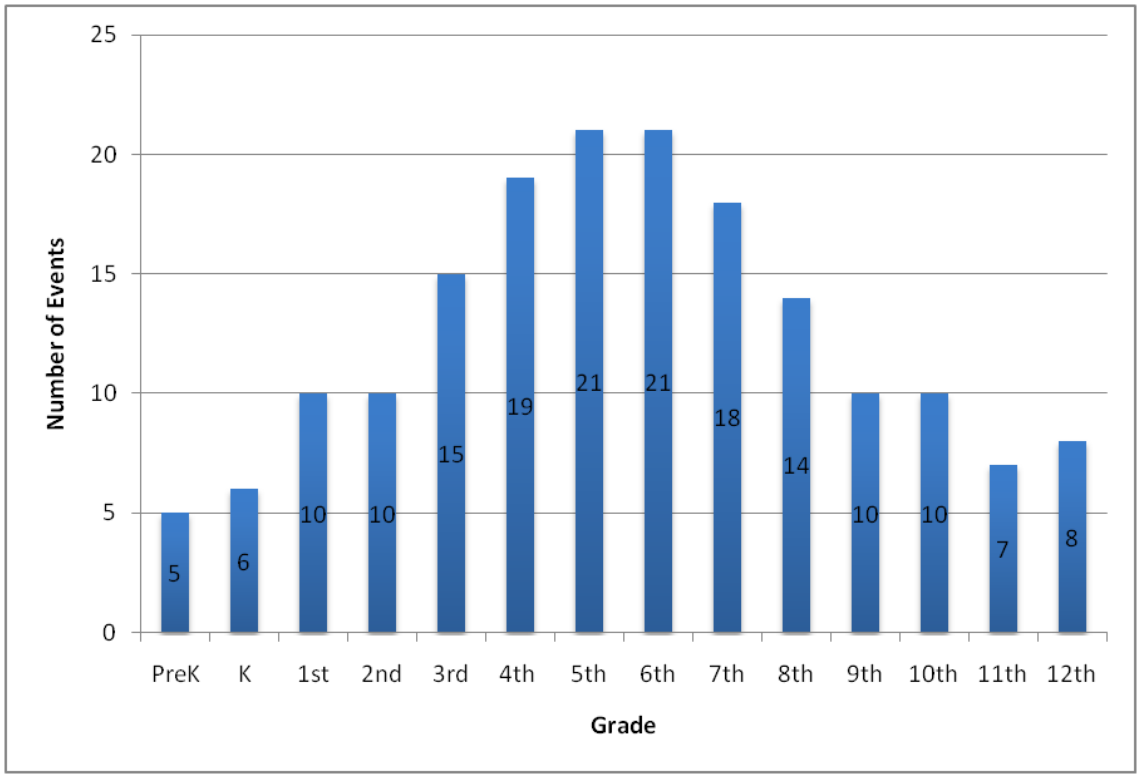
## Youth Group Observations

To learn more about the effectiveness of the training for adults on inquiry-based learning methods and the extent to which the methods were used with the POW curriculum and project, MEs were invited to observe two separate youth sessions for each of their AEs. To carry out the observations, MEs used an observation tool developed by POW evaluators. Using the tool, an ME observed a POW learning experience without interacting with the AE or the youth in the group. After the observation, the ME debriefed with the AE to share their general observations and support the AE in planning for ways to strengthen the POW youth sessions as needed.



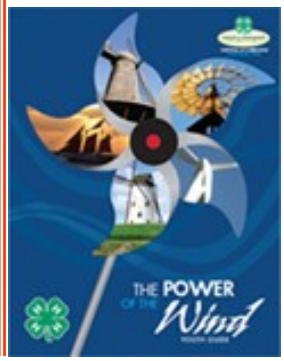

Seven observations of youth groups were completed across four of the states. A limited number of youth groups formed early in the project (see Table 2) with many of the groups starting spring 2010, which limited the number of observations that could take place before the end of the project. Although the sample size is small, the results reported here provide a glimpse into how inquiry-based learning was approached in POW groups.

## Figure 2: Grade levels reached by events (n= 32 events)




## Summary of Observations

MEs observed the AE's role in the inquiry-based learning process. The inquiry process is made up of steps that include Questioning, Planning, Designing, Investigating, Reporting, and Raising the Next Question. When process was part of the experience observed during that session, the observing Master Explorer indicated whether it was completely or mostly adult-led or completely or mostly youth-led. As illustrated in Table 11, investigating was observed in all of the groups, while helping youth come up with an additional question was observed least often across the groups. Investigating was most frequently observed to be mostly or completely youth-led. Questioning, planning, and reporting had a lot of adult influence, being either mostly or completely adult-led in a majority of the observed groups. It is important to note that ME's were trained in using the observation form but were not trained in observational methods. The rating form items were structured to reflect the underlying learning methods from the original training, upon which the program theory was based. These ratings assigned by the ME's were based on the individual ME's interpretation of both the AE and youth behaviors observed and their interpretation of the meaning of the items on the rating form. Even with these significant limitations, the rating method was helpful in focusing the attention of the key partners of the project on developing an understanding about the effectiveness of, and a collective understanding about, the learning methods at the core of the pilot model.



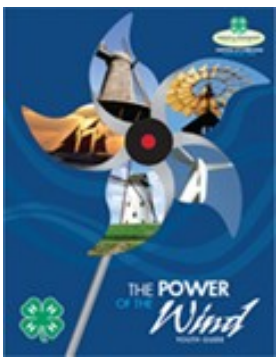
## Table 4: Youth and Adults' role in inquiry process

| | Completely adult-led | Mostly adult-led | Mostly youth-led | Completely youth-led |
|---|---|---|---|---|
| Questioning (n=5) | 0 | 4 | 1 | 0 |
| Planning (n=6) | 3 | 1 | 2 | 0 |
| Designing (n=5) | 0 | 1 | 3 | 1 |
| Investigating (n=7) | 1 | 1 | 2 | 3 |
| Reporting (n=6) | 3 | 1 | 1 | 1 |
| Next Question (n=4) | 0 | 2 | 0 | 2 |

*Note: The "n" value is the number of groups in which MEs observed each aspect of the inquiry process.*

MEs were asked what might have been "getting in the way" of youth asking their own questions during the learning experience. These comments reflect the challenge in implementing learning methods that are more highly youth-directed. MEs noted a variety of things including the structure of the activities and the level of the AE's involvement in the lesson.

- The AE directed the activities, asking the students to build a pinwheel, test the blades, and assemble the kit (all activities were completely adult-led).
- Lessons were structured with given questions by design. Youth were able to build subquestions to address group task. Another issue is the involvement of AE.
- Youth focused on constructing the device. Very elementary questions about how the device worked.
- The nature of the activity and time frame (40 minutes). If he had more time, I think it would have been possible for him to implement more of the testing phase with the devices, which I know he planned to do. One thing that is hard about the after-school environment is that in some instances, the youth can drift off to the other activities once they perceive they are "done" but really that is the point where they are just getting started with their testing.
- I thought this went well. The longer time frame that she had (1 hour) – some science classes go shorter – really allowed for the kids to do more student-led investigation.
- They all seemed engaged. The only thing getting in the way may have been the lack of equipment. Had to work in groups.
- This session was led by a "veteran" 4-H instructor who did an outstanding job.




MEs also looked for particular behaviors related to the inquiry process. Every eight minutes, MEs looked for 10 different behaviors and rated the highest level of activity that occurred for each behavior during that time interval (See Appendix D for the observation checklist for the 10 behaviors ). Reported below are the results across six of the observed sessions.

### *Behavior 1: Adult encourages youth to use materials related to the lesson to form their own questions.*

- In five of the groups, AEs encouraged youth to "mess around" with the materials to form their own questions.
- One AE talked to the youth about how to use the materials to form questions, but didn't get to the point where youth could mess around with the materials.

### *Behavior 2: Adult acknowledges questions posed by youth with respectful nonverbal and/or verbal responses.*

- In all of the groups, the AE acknowledged the questions posed by the youth with respectful responses. One ME noted in their observations that the AE did *"an excellent job redirecting the questions back to the students."*

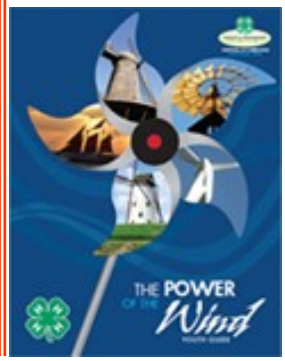
### *Behavior 3: Adult reinforces questions posed by youth by asking a follow-up question.*

- All of the groups had instances where the AE acknowledged youths' questions and responded with a follow-up question. MEs noted some of the questions posed by AEs including, *"How would you change it (so it works)?" "How could you test that?"*

### *Behavior 4: Adult reinforces questions posed by youth by asking youth to explore the question further.*

- In five of the groups, the AE encouraged youth to further explore their own questions. This often occurred once youth started conducting their own investigation during their session. In one instance, the ME noted that the AE used words such as *"Why? How? What would you do differently? To what extent?"* to encourage youth to further explore their question.
- In one group, the adult acknowledged youth questions, but never got to the point where he/she was encouraging the youth to explore the questions further. Instead of creating a student-led discussion of the question, the ME observed the AE controlling the discussion.

### *Behavior 5: Adult guides youth in changing questions investigated (using "what, which, did, who, is, when, or how" root words to form questions).*




- Only two of the AEs were observed guiding youth to change his/her questions to make them investigable. The MEs noted that they specifically observed the AEs posing many of the root words back to the youth.
- In two of the groups, the AEs changed the questions for the youth instead of guiding the youth to change their own questions.
- In two of the groups, the ME did not observe the AE talking to youth about changing their questions. Although one ME noted that the questions were already "how" or "what."

### *Behavior 6: Large group or small group discussion occur about whether a question could be investigated.*

- In all of the groups, discussions occurred about whether a question could be investigated.

### *Behavior 7: Youth show signs that they know a question that focuses their investigating.*

- In five of the groups, the ME observed at least three youth showing signs that they knew a specific question to focus their investigation. In one group, the ME noted that at the end of the session youth were encouraged to share their observations and questions with the group. Another ME noted that he/she observed youth modifying their boats to test the effects of different variables in order to answer their question.
- In one group, only one or two youth showed signs that they knew a question to focus their investigation. The ME noted that many youth ended the activity without making modifications to their designs to see which changes would affect the amps spun.

### *Behavior 8: Youth observe the investigating of other youth.*

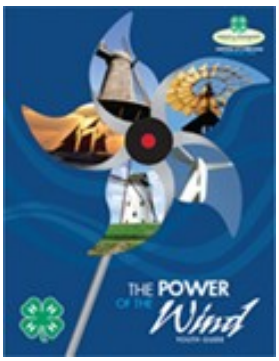
- In five of the groups, three or more youth observed other youth investigating. One ME noted, *" I definitely saw a progression. Youth were very intently focused on their own boats at first but once they started testing them they started to compare!"* Another ME noted that some youth needed to see others' ideas to get started themselves.
- In one of the groups, only one or two youth observed others, and this was only when most designs were already completed.

### *Behavior 9: Youth approached other youth with questions and requests for ideas.*

- In five of the groups, three or more youth were observed approaching other youth. One ME noted that, *"the observing of other youth went hand in hand with them questioning each other."*
- In one group, only one or two youth approached other youth with questions. The questioning occurred toward the end of the meeting as youth were starting to adjust their designs. They asked questions and compared what they were doing to other youths' designs.

### *Behavior 10: Adult is attentive and available to respond to youth requests for help.*

- In all of the groups, the adult was attentive to youth requests for help. The type of assistance varied, from the adult answering youth questions directly to helping youth find their own answers. In five of the groups, MEs observed instances where AEs guided youth to find his/her answer. However, in three of these groups, most of the instances involved the adult providing youth with answers directly to their questions or telling them how to find the answer.

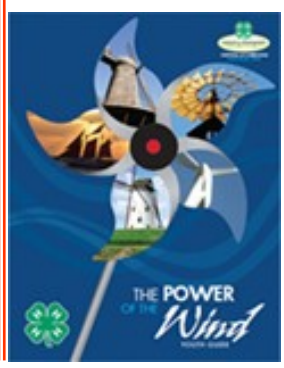


The observation method also enriched the ongoing learning between the Master Explorer and the Adult Explorer in the cases in which it was used. All of the MEs had plans to share their observations with the AE. Four of the MEs discussed the observations right away after the session. Three MEs planned to discuss the observations at a later date. One ME said he was going to have an *"online meeting to debrief early experiences and share successes and concerns."* Another MEs said she was going to *"send a copy of the DVD (of the session) and this blank observation sheet and ask the AE to evaluate himself. Then we can discuss what went well and what needs improvement."*

MEs also reflected on the observations in terms of how they might alter their AE trainings. MEs most frequently noted changes they would make to how they trained AEs in the inquiry process (see below).

## What MEs would change about their AE trainings (n=7)

- Biggest concern is AEs just imitating MEs, which turns into series of activities not an inquiry approach. Time and follow-up necessary to build confidence and comfort in the inquiry process.
- We need to spend more time training adult volunteers to use the inquiry method!!! Especially with teachers like the AE I observed who are used to directing all aspects of learning.
- I'd like to do some research and investigate some best practices on two topics to be subsequently incorporated in to the training. How to best encourage inquiry in activities where the construction phase is somewhat complicated and requires a lot of adult input (i.e. an activity where it is more difficult for you to make the adjustments on their own. I assume inquiry model I would be able to use here) and also how to maintain student interest through the testing and refining model.
- I thought AE was quite effective given the afterschool setting. I might spend time at a training to "step through" an activity and discuss the behaviors by the volunteer at each step they would encourage student inquiry.
- How to teach and learn the basics of the wind kits.
- No changes to be recommended except to keep extra materials for the POW kits.
- I think the AE did a great job. He seemed to well understand the method of inquiry.




## Youth Feedback

Youth were invited to participate in an online survey toward the end of the grant period in May 2010. The purpose of the survey was to understand and gain feedback on youths' experiences with POW activities. State partners decided which youth groups to involve in the surveys. The criteria for involvement was that youth had to be part of a group that was participating in POW activities beyond a one-time event. The group had to have met more than once so that youth were exposed to a

variety of POW activities before answering the survey questions. A total of 30 youth from two states (Iowa and Missouri) participated in the survey. Youth became involved in POW for a variety of reasons. As shown in Table 12, half of the youth said they wanted to learn something new about wind energy and a fifth cited their interest in the topic. Youth also mentioned how others influenced their involvement in POW, either their parent signed them up or POW activities were offered as part of their pre-existing group. For full responses under each theme, see Appendix D.

## Table 12. Main reason youth became involved in POW (n=20)

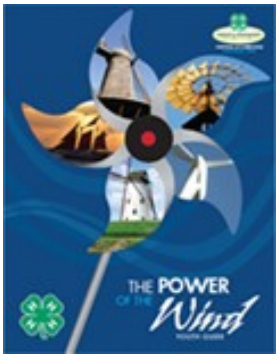
| Theme | Percent of Youth |
|---|---|
| To learn something new | 50% (10) |
| Interested in the topic | 20% (4) |
| Parent signed him/her up | 15% (3) |
| Did POW during a pre-existing group | 15% (3) |

Most youth had a positive experience with POW. As illustrated in Table 13, three quarters of youth had fun doing POW activities and close to two thirds would like to do more POW in the future. Less than half of the youth would recommend POW to their friends. Overall, most youth agreed at least a little with all three statements.

## Table 13: Overall POW experience

| | Disagree | Disagree a little | Agree a little | Agree |
|---|---|---|---|---|
| I had fun doing 4-H POW activities. (n=29) | 0% | 0% | 24% (7) | 76% (22) |
| I would recommend POW to my friends. (n=28) | 0% | 14% (4) | 43% (12) | 43% (12) |
| I would like to do more POW in the future. (n=28) | 11% (3) | 4% (1) | 25% (7) | 61% (17) |

Youth enjoyed various aspects of their POW experience. When asked what their favorite thing was about working with POW, they cited a variety of things, with some youth mentioning more than one aspect that was their favorite. As illustrated in Table 14, most youth cited POW's hands-on activities, including testing blades, making pinwheels, building wind turbines, and using the circuits. A small percentage of youth (15%) said they liked the opportunity to direct their own experience with POW activities, part of the inquiry-based learning process AEs were trained to use with their groups. For full responses from youth about their favorite aspects of working with POW, see Appendix E.



## Table 14: Youths' favorite thing about working with POW (n=26)

| Theme | Percent of Youth |
|---|---|
| Testing blades | 27% (7) |
| Inquiry process | 15% (4) |
| Making pinwheels | 15% (4) |
| Building wind turbines | 15% (4) |
| Using circuits | 8% (2) |
| Other | 23% (6) |

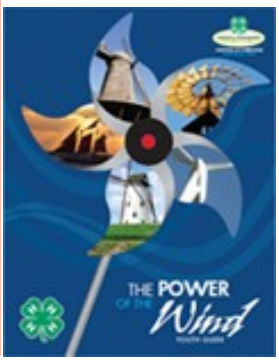
Although most youth had fun doing POW and would like to do more activities in the future, a majority of youth did not share their experience with others. A little more than a third talked about POW with people they lived with (see Table 15). Only two youth shared their experience with friends.

## Table 15: Talking to others about POW (n=28)

| | Yes | No |
|---|---|---|
| Have you talked about POW with people you live with? | 36% (10) | 64% (18) |
| Have you talked about POW with your friends? | 7% (2) | 93% (26) |

POW activities provided youth with opportunities to learn about wind energy, engineering, and scientific inquiry. As illustrated in Table 16, most of the youth agreed at least a little bit that they learned interesting things doing 4-H POW activities. Only a third of youth felt they could explain wind energy to someone else, with another third agreeing a little bit that they could explain the topic. However, there were close to a third of youth that didn't feel confident enough in their understanding about wind energy to be able to explain the topic. This direct report from youth differs from the AE perspectives in which the adults reported that the youth were effective in explaining wind energy to others. Although a majority of youth didn't feel completely confident in their ability to talk about wind energy with others, their curiosity was piqued by the topic. Almost two-thirds of youth said POW has made them more curious about wind energy.

## Table 16: Youths' interest and knowledge of wind energy (n=29)




| | Disagree | Disagree a little | Agree a little | Agree |
|---|---|---|---|---|
| I learned interesting things in 4-H POW. | 3% (1) | 3% (1) | 45% (13) | 48% (14) |
| I could explain wind energy to someone else. | 17% (5) | 14% (4) | 34% (10) | 34% (10) |
| POW has made me more curious about wind energy. | 7% (2) | 0% | 31% (9) | 62% (18) |

Youths' confidence in carrying out steps of the inquiry process varied. As illustrated in Table 17, half the youth felt confident carrying out an investigation. However, lower percentages of youth felt confident asking science-related questions and planning an investigation. A fifth to a third of the youth disagreed that POW increased their confidence in the various steps of the inquiry process.

## Table 17: Youths' confidence with steps of the inquiry process

| | Disagree | Disagree a little | Agree a little | Agree |
|---|---|---|---|---|
| Because of POW, I feel more confident asking science-related questions. (n=29) | 24% (7) | 3% (1) | 48% (14) | 24% (7) |
| Because of POW I feel more confident planning an investigation. (n=28) | 14% (4) | 18% (5) | 29% (8) | 39% (11) |
| Because of POW, I feel more confident carrying out an investigation. (n=29) | 10% (3) | 10% (3) | 28% (8) | 52% (15) |

POW had some success at helping youth feel like a scientist or engineer. Around a third of youth said they felt like a scientist or engineer when participating in POW activities (see Table 18). Overall, close to three quarters agreed at least somewhat that they felt like a scientist, while two thirds had at least some agreement that they felt like an engineer.

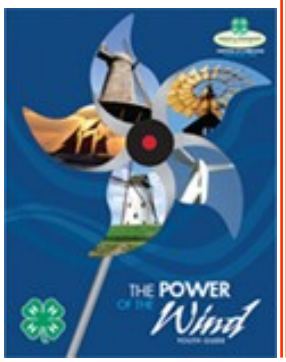
## Table 18: POW activities help youth feel like a scientist or engineer (n=29)

| | Disagree | Disagree a little | Agree a little | Agree |
|---|---|---|---|---|
| I felt like a scientist when working with 4-H POW activities. | 7% (2) | 17% (5) | 38% (11) | 38% (11) |
| I felt like an engineer when working with POW activities. | 7% (2) | 28% (8) | 34% (10) | 31% (9) |

POW activities were used with youth of all ages. Survey respondents exemplify this use, ranging in age from 1st – 12th grade. Regardless of age, most youth (84%) felt the activities were just right or easy for them (see Table 19). Only two youth felt the activities were too hard.

## Table 19: Difficulty of POW activities for youth (n=26)

| | Too hard | A little hard | Just right | A little easy | Too easy |
|---|---|---|---|---|---|
| Overall, how difficult were the POW activities for you? | 8% (2) | 8% (2) | 38% (10) | 38% (10) | 8% (2) |



Youth provided feedback on POW to help identify areas of improvement. Youth cited a variety of their least favorite things about working with POW. As illustrated in Table 20, youth mentioned aspects of the POW materials, watching videos, instructional aspects of the curriculum, and a variety of other elements of POW activities. A fifth of youth said they didn't have a least favorite thing about POW. To understand what is included under each theme, see Appendix F for full responses from youth.

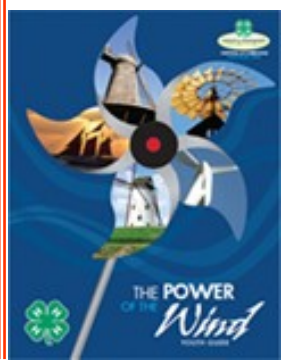
## Table 20: Youths' least favorite thing about working with POW (n=20)

| Theme | Percent of Youth |
|---|---|
| Aspects of the materials | 15% (3) |
| Watching videos | 10% (2) |
| Instructional aspects | 10% (2) |
| Other | 30% (6) |
| Nothing was least favorite | 20% (4) |
| Not sure what was least favorite | 15% (3) |

Youth were asked how 4-H leaders could improve the experience youth have working with POW. Ten of the youth provided suggestions. As listed below, youth had a wide variety of suggestions including changes to the hands-on activities and more explanation of wind energy. Four of the youth said they didn't have any suggestions for improvement and four youth weren't sure what they would change.

## What 4-H leaders should do to improve the experience youth have working with POW (n=18)

- Have us do separate ones.
- They can do different levels for different people.
- Make it more creative.
- Maybe going outside to do it.
- Show me a little how each thing works.
- Explain why it works.
- It's a bit boring at the beginning.
- Wind helps me.
- More toys!
- Look for larger variety of kits.




Survey respondents included a diversity of youth. More girls (60%) than boys (40%) responded to the survey. As illustrated in Table 21, youth spanned a range of grades from 1st to 12th grade.

### Table 21: Grade of youth respondents (n=26)

| Grade | Percent of Youth |
|---|---|
| 1st grade | 8% (2) |
| 2nd grade | 4% (1) |
| 3rd grade | 12% (3) |
| 4th grade | 15% (4) |
| 5th grade | 15% (4) |
| 6th grade | 19% (5) |
| 7th grade | 0% |
| 8th grade | 4% (1) |
| 9th grade | 4% (1) |
| 10th grade | 4% (1) |
| 11th grade | 4% (1) |
| 12th grade | 12% (3) |

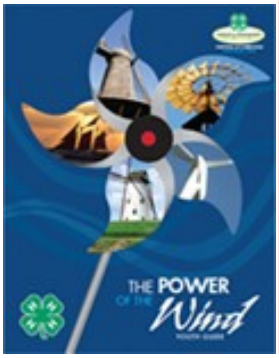
### Table 22: Length of youth involvement in 4-H (n=27)

| Years | Percent of Youth |
|---|---|
| 1 year | 44% (12) |
| 2 years | 22% (6) |
| 3 years | 4% (1) |
| 4 or more years | 30% (8) |

Youth had varying levels of prior experience with 4-H. As shown in Table 22, over two fifths of youth were participating in 4-H for the first time that year. Close to a third of youth had extended involvement with 4-H and had four or more years of experience with 4-H.

## Section 6: Future POW Plans for States

The POW grant provided each state with funds and resources to create the infrastructure to train and disseminate the POW curriculum to adult and youth leaders throughout their state. All six states have plans to continue POW activities beyond the life of the grant. States' dedication to POW was evident in the way they talked about the future of POW efforts during the end of project interviews. *"Renewable energy resources are something we need to keep on the forefront of everyone's mind…Will definitely keep (POW) in Texas. Too good of a teaching tool for the kids and gets across the scientific method."* States' plans for POW include continuing to offer trainings, providing educational tools, and increasing the number of youth reached through various informal education activities.



# Appendix A

## Power of the Wind State Partners

- Jay Staker, Iowa
- Patricia Higby, Iowa
- Harmon Wilts, Minnesota
- Jacqueline Paulson, Minnesota
- Pamela Larson Nippolt, Minnesota
- Stan Simon, Minnesota
- Bill Pabst, Missouri
- Jerry Baker, Missouri
- Ollie Bogdon, Missouri
- Shawn Deering, Missouri
- Alice Nickelson, South Dakota
- Carolyn Hendricks, South Dakota
- Kathy Reeves, South Dakota
- Matt Tarpley, Texas
- Cathy Vrentas, Wisconsin
- Ian Meeker, Wisconsin

## Power of the Wind Advisory Team Members

- **Carol Anderson,** Retired Extension professional from Cornell (manages the Iowa County wind farm)
- **Greg Cuomo,** Associate Dean, EFAN, U of MN Twin Cities
- **Paul Imbertson,** Associate Education Specialist, Electrical and Computer Engineering, U of MN Twin Cities
- **Lizbeth Kliewer,** Minnesota 4-H Foundation Board Chair
- **Mike Lindstrom,** SciMathMN Executive Director
- **Lowell Rasmussen,** Vice Chancellor, U of MN - Morris Plant Services Admin
- **Mike Reese,** Coordinator of West Central Research/Outreach Center, U of MN Morris
- **Ken Schlimgen,** Director of Member Services & Marketing, Central Electric Cooperative
- **Mike Strommen,** 3M Renewable Energy
- **Jacqueline D. Hamilton,** P.G., GISP GIS Project Manager, HDR ONE COMPANY Many Solutions